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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SAM YANG and DAN GEALY

Appeal 2008-3384
Application 09/588,008
Technology Center 2800

Decided: September 24, 2008

Before THOMAS A. WALTZ, PETER F. KRATZ, and
CATHERINE Q. TIMM, *Administrative Patent Judges*.

WALTZ, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants seek review under 35 U.S.C. § 134 from the Examiner's rejections of claims 1-31 and 99 in the Final Office Action, dated September 22, 2006. This Board has jurisdiction under 35 U.S.C. § 6(b). For the reasons discussed below, the rejections of the Examiner are AFFIRMED.

The invention of the present application is directed to a capacitor for a semiconductor device. Claim 1 is illustrative and reproduced below:

> 1. A capacitor for a semiconductor device, said capacitor comprising:
>
> a bottom conducting layer, wherein said bottom conducting layer is a bottom electrode;
>
> an annealed dielectric layer formed over said bottom conducting layer, wherein said annealed layer is annealed with a first annealing process; and
>
> a top electrode consisting of a single oxidized gas annealed top conducting layer formed over said annealed dielectric layer, wherein said annealed top conducting layer is annealed with a second annealing process.

The Examiner relies on the following prior art as evidence of unpatentability:

Emesh	5,452,178	Sep. 19, 1995
Alers	6,303,426 B1	Oct. 16, 2001
Iizuka	6,338,996 B1	Jan. 15, 2002
Marsh	6,387,802 B1	May 14, 2002
Narwankar	6,475,854 B2	Nov. 5, 2002

The following rejections are presented for review:

1. Claims 1-3, 7-16, 18-25, 29-31, and 99 stand rejected under 35 U.S.C. § 102(e) as anticipated by Iizuka (Ans. 3).

2. Claims 4, 5, and 17 stand rejected under 35 U.S.C. § 103(a) as obvious over Iizuka in view of Emesh (Ans. 6).

3. Claims 6 and 14 stand rejected under 35 U.S.C. § 103(a) as obvious over Iizuka in view of Alers (Ans. 7).

4. Claims 26-27 stand rejected under 35 U.S.C. § 102(e) as anticipated by Iizuka, or in the alternative, under 35 U.S.C. § 103(a) as obvious over Iizuka in view of Narwankar (Ans. 8).

5. Claim 28 stands rejected under 102(e) as anticipated by Iizuka, or in the alternative, under 35 U.S.C. § 103(a) as obvious over Iizuka in view of Marsh (Ans. 9).[1]

FINDINGS OF FACT (FF)

As related to the discussions and issues raised herein, the following findings of fact are made.

1. Iizuka teaches a method for producing a highly dielectric thin film capacitor formed by layering first a noble metal lower electrode, then a dielectric film, and subsequently a noble metal upper electrode, col. 2, ll. 25-30.

2. In a second embodiment, Iizuka teaches that after formation, the layered capacitor is annealed in a gas mixture of oxygen, in an amount 5% or lower, and nitrogen under 1 atmosphere pressure and 300-400º C temperature, col. 4, ll. 56-60.

3. Iizuka teaches that annealing a capacitor in an oxygen atmosphere causes a rearrangement of the boundary between the electrode

[1] We note that the Examiner has mistakenly omitted Marsh from the statement of the rejection (Ans. 9). However, the Examiner correctly discusses Marsh in combination with Iizuka (Ans. 12), and this combination of references has been recognized and discussed by Appellants (Br. 6). Therefore, we consider the omission of Marsh from the statement of the rejection to be harmless error.

and dielectric layer (BST thin film) to improve the crystallization of the boundary between the electrode and the dielectric layer. This reduces the leak current at room temperature and suppresses the leak current increase during high temperature operation. Col. 5, l. 49 to col. 6, l. 6.

4. Emesh discloses a capacitor having an electrode, an overlying dielectric layer, col. 6, l. 26 – col. 7, l. 1, and a second overlying electrode, col. 7, l. 21-23. The first electrode may be fabricated of a suitable conductive metal, alloy or conductive metal oxide. Col. 7, ll. 1-3. The second electrode may be a suitable noble metal, metal alloy or conductive metal oxide, col. 9, ll. 40-42.

5. Alers teaches a capacitor having a lower electrode layer 66 comprising a metal nitride, overlaid by a dielectric material 70, col. 3, ll. 53-59, *see* Fig. 3. The dielectric layer 70 is deposited by chemical vapor deposition of tantalum oxide (TaO), titanium oxide (TiO), zirconium oxide (ZrO), or barium strontium titanate (BaSrTiO), col. 3, ll. 59-62.

6. Narwankar teaches a capacitor with a bottom electrode 604, a dielectric layer 606, and a top electrode 610, *see*, Figs. 1 and 6f, wherein the top electrode is annealed in an oxygen environment, col. 11, ll. 4-6. The annealing is plasma-enhanced, or remote plasma enhanced, col. 13, ll. 14-20, and is done at a pressure of 2.5 Torr over a period of 2 minutes, col. 13, ll. 10-15.

7. Marsh teaches depositing a platinum based metal film by CVD deposition including bubbling a non-reactive gas through an organic platinum based metal precursor. The platinum based film is deposited onto a non-silicon bearing substrate in a CVD deposition chamber in the presence of ultraviolet light at a predetermined temperature and under a

predetermined pressure. The film is then annealed in an oxygen atmosphere. Abstract.

PRINCIPLES OF LAW

"During examination, 'claims . . . are to be given their broadest reasonable interpretation consistent with the specification, and . . . claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art.'" *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004)

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987), *cert. denied*, 484 U.S. 827 (1987)

"Section 103 forbids issuance of a patent when 'the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.'" *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007)

The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of ordinary skill in the art, and (4) where in evidence, so-called secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966)

When a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield predictable results to be patentable under 35 U.S.C. § 103(a). *KSR,* 127 S. Ct. at 1740.

If a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. *Id.*

The method of claiming a product by listing the steps to obtain it, commonly called a product-by-process claim, is perfectly acceptable and does not inherently conflict with the second paragraph of 35 U.S.C. §112, so long as the claims particularly point out and distinctly claim the product for which protection is sought. However, when the prior art discloses a product which reasonably appears to be identical with or only slightly different than a product claimed in a product-by-process claim, a rejection based alternatively on either section 102 or 103 is eminently fair and acceptable. *In re Brown,* 459 F.2d 531, 535 (CCPA 1972).

Patentability is determined by the product itself, and does not depend on the method of production. *In re Thorpe,* 777 F.2d 695, 697 (Fed. Cir. 1985). The PTO has the initial burden of providing evidence that the product described by the prior art is the same product which is claimed. *In re Marosi*, 710 F.2d 799, 802 (Fed. Cir. 1983). Once a prima facie case has been established, the burden shifts to Appellants "to prove that the prior art products do not necessarily or inherently possess the characteristics of [their] claimed product." *In re Fitzgerald*, 619 F.2d 67, 70 (CCPA 1980); *In re Best*, 562 F.2d 1252, 1255 (CCPA 1977).

In re Fulton, 391 F.3d 1195, 1201 (Fed. Cir. 2004) states that "[t]he prior art's mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed in the … application."

In re Gurley, 27 F.3d 551, 552-53 (Fed. Cir. 1994), holds that "[a] reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant."

DISCUSSION

Claim Construction

"oxidizing gas annealed"

Claims 1 has a limitation directed to an oxidizing gas annealed layer. The relevant excerpt from the Specification states:

> Suitable oxidizing gas compounds for use in the second anneal step include: Oxygen (O_2), Ozone (0_3), Nitrous Oxide (N_2O), Nitric Oxide (NO), and water vapor (H_2O). These gases can be introduced individually into an oxidizing chamber or can be produced from reactions of other materials in the oxidization chamber. The oxidizing gas could also be a mixture of one or more these gases with an inert gas such as Argon (Ar), Helium (He),

> Nitrogen (N_2), or other compound mixtures which produces reacting oxygen ions.

Spec. 8:14-20.

Accordingly, we construe the claim term, "oxidizing gas annealed," to be understood by one skilled in the art as meaning a material which has been annealed using a gas consisting at least of one or more of the gases oxygen, ozone, nitrous oxide, nitric oxide and water vapor, either alone or in a mixture of one or more inert gases consisting of argon, helium, and nitrogen. We further construe this term to be a product by process limitation.

Anticipation by Iizuka

Under the first rejection, claims 1-3, 7-16, 18-25, 29-31, and 99 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Iizuka. Appellants do not argue the patentability of the claims separately, but argue for claim 1, and for the other claims based on their dependency on claim 1. Accordingly, the claims of this rejection are treated as a group, to stand or fall together, with claim 1 as representative. 37 C.F.R. § 41.37(c)(1)(vii).

Regarding claim 1, the Examiner contends Iizuka discloses all its elements, Ans. 3. We agree. Iizuka discloses a capacitor device comprising a layered structure of a bottom electrode, a dielectric layer and a top electrode, FF 1. The layers are annealed using an oxygen and nitrogen gas annealing process, FF 2. As we have construed the term, "oxidizing gas annealed," *infra*, Iizuka discloses an oxidizing gas annealed layer.

Appellants do not contend that Iizuka does not disclose an oxidized gas annealed layer, but rather that it fails to teach an annealed dielectric layer annealed by a first annealing process, and then a top electrode with a gas annealed conducting layer annealed by a subsequent second annealing

process for the top electrode. Appellants contend that the claim must be read as limiting the device to one produced by two distinct, sequential anneal processes, App. Br. 11.

The claim is directed to a device or structure, namely a capacitor. However, the limitations at issue here are directed to the method for producing the capacitor. Claiming a device or structure in terms of the method of producing it is acceptable, but it is the patentability of the resulting product claimed, not the process steps, which must be established. *In re Brown,* 459 F.2d at 535.

The Examiner bears the initial burden of showing the claimed invention to be identical to or an obvious modification of the prior art. *In re Marosi*, 710 F.2d at 802. We determine that the Examiner has done so. The Examiner has shown that Iizuka teaches a capacitor having a bottom conducting layer, an annealed dielectric layer and an oxidizing gas annealed top electrode layer. Ans. 3. As shown by the Examiner, the capacitor disclosed in Iizuka has the same characteristics and properties of Appellants' claimed invention, namely, improved crystallization at the boundary between the electrode and the dielectric layer. This reduces the leak current at room temperature and suppresses the leak current increase during high temperature operation (FF 3). *See*, Spec., p. 4, l. 20 – p. 5, l. 4.

The burden thus shifts to Appellants to show that the prior art does not necessarily or inherently possess the characteristics of their claimed device. *Fitzgerald*, 619 F.2d at 70. We determine the Appellants have failed to do so. Appellants have merely pointed out the differences in the number or sequence of annealing steps performed, App. Br. 10, without showing any inherent differences in the structure of the annealed layers of the capacitor

resulting from the claimed sequential annealing steps and that of the prior art.

Accordingly, the first rejection of the Examiner is sustained.

Obviousness over Iizuka in view of Emesh

Claims 4, 5 and 17 stand rejected under 35 U.S.C. § 103(a) as obvious over Iizuka in view of Emesh. Claims 4 and 5 depend on claim 1, adding a further limitation that the bottom conducting layer is formed of a metal alloy and a conducting metal oxide, respectively. Claim 17 depends on claim 1, adding a further limitation that the top conducting layer is formed of a conducting metal oxide.

The Examiner contends that Emesh discloses an analogous device in which the bottom electrode may be formed of a metal alloy or metal oxide, and the top electrode of a conducting metal oxide. Ans. 6. We agree with the Examiner's findings. *See* FF 4. We determine that the substitution of metal alloy or metal oxide for the top or bottom electrode, as applicable, taught in Emesh, for the noble metal electrodes of Iizuka would have been obvious to one of ordinary skill in the art at the time of the invention. *KSR*, 127 S. Ct. at 1740.

Appellants traverse the Examiner's rejection, arguing first, claim 1, upon which these claims all depend, is patentable as Iizuka does not teach all the limitations of claim 1, and that Emesh fails to correct this deficiency. As we have sustained the anticipation of claim 1 by Iizuka, this argument is unpersuasive.

Appellants then argue that Iizuka teaches away from the substitution, as Iizuka specifically discloses the upper and lower electrodes are formed of a noble metal, without any teaching that they may also be formed of a metal

alloy or conducting metal oxide, as applicable. We do not find this persuasive. Iizuka does not discourage a skilled practitioner from making the combination and one of ordinary skill in the art would not have been led in a divergent direction (*In re Gurley,* 27 F.3d at 553). Nor does Iizuka criticize, discredit or otherwise discourage the solution claimed in the application. *In re Fulton*, 391 F.3d at 1201. We do not find anything in the cited prior art which teaches away from substituting the electrode materials in Emesh for those in Iizuka.

Accordingly, the Examiner's second rejection is sustained.

Obviousness over Iizuka in view of Alers

Claims 6 and 14 stand rejected under 35 U.S.C. § 103(a) as obvious over Iizuka in view of Alers. Claim 6 depends on claim 1, adding a further limitation that the bottom conducting layer is formed of a metal nitride. Claim 14 likewise depends on claim 1, adding a further limitation that the dielectric layer is tantalum oxide and is amorphous or crystalline. The Examiner contends Alers teaches an analogous device with these additional limitations, Ans. 7. We agree that Alers teaches a tantalum oxide dielectric layer, FF 5, which necessarily must be either amorphous (non-crystalline) or crystalline.

Appellants traverse this rejection by first arguing that claim 1, upon which these claims depend, should be found allowable, and that Alers does not cure the deficiencies of Iizuka. App. Br. 13-14. However, as we have found claim 1 is anticipated by Iizuka, this argument is unpersuasive.

Appellants also argue that Iizuka teaches away from substituting another material for its electrodes, as it teaches only of noble metal

electrodes. This argument is unpersuasive, for the same reasons discussed in the second rejection, *supra*.

Accordingly, the third rejection is sustained.

Anticipation / Obviousness over Iizuka in view of Narwankar

Claims 26 and 27 were rejected under 35 U.S.C. § 102(e) over Iizuka, or alternatively under 35 U.S.C. § 103(a) over Iizuka in view of Narwankar. Claim 26 depends on claims 1 and 23[2], adding a limitation that the annealed top conducting layer is a plasma enhanced annealed top conducting layer. Claim 27 likewise depends on claims 1 and 23, adding a limitation that the annealed top conducting layer is a remote plasma enhanced annealed top conducting layer. These limitations are directed to modifications of the annealing process step, and not descriptive of any limitation in the final structure of the claimed capacitor device. As such, it does not distinguish the device from the prior art, *Thorpe*, 777 F.2d at 698. We therefore determine that, lacking further limitations over the structure recited in claim 1, claims 26 and 27 are also anticipated by Iizuka.

The Examiner contends Narwankar teaches an analogous method and device, in which an oxidizing anneal step is plasma-enhanced or remote-plasma-enhanced. Ans. 8. We agree, FF 6.

Appellants do not dispute that Narwankar teaches a plasma enhanced annealed layer, App. Br. 15, but rather that neither it, nor Iizuka, disclose distinct first and second annealing processes, *Id.* This argument was addressed and found unpersuasive in the discussion related to the first rejection, and our comments are likewise adopted here.

[2] Claim 23 adds a limitation that the top conducting layer of claim 1 is annealed with an oxygen compound.

Additionally, we determine the limitations of claims 26 and 27 to be an obvious use of a known technique, (remote) plasma enhancement, to improve a similar method, namely an oxidizing anneal process, in the same way to achieve predictable results. *KSR,* 127 S. Ct. 1740.

The rejections under § 102(e), or alternatively under § 103(a), is sustained.

Anticipation by Iizuka / Obviousness over Iizuka in view of Marsh

Claim 28 stands rejected under 35 U.S.C. § 102(e) as anticipated by Iizuka or, alternatively, under 35 U.S.C. § 103(a) as obvious over Iizuka in view of Marsh. Claim 28 depends on claims 1 and 23, adding a further limitation that the annealed top layer is an ultraviolet light enhanced annealed top conducting layer.

For the same rationale as the prior rejection analysis, we determine that the limitation is directed to a process step without any identified patentable distinction made to the structure of the claimed capacitor. *Thorpe,* 777 F.2d at 698. While Iizuka does not explicitly teach of a step of ultra violet light enhancement, nothing in the specification or the prior art reveals that the resulting capacitor structure would be different than or patentably distinct from one fabricated without the enhancement. Appellants do not show that the capacitor as claimed is patentably distinguishable from that disclosed in Iizuka. For similar reasons as stated above, we determine that Iizuka anticipates the subject matter of claim 28. Our reasons are similar for the rejection of claim 28 over Iizuka in view of Marsh. Appellants argue that Iizuka does not teach an ultraviolet enhanced top electrode, and Marsh does not cure the deficiency of Iizuka for failing to disclose distinct first and second anneal processes. App. Br. 15-16.

Regardless, the limitation of ultraviolet-enhanced annealed electrode, as well as the inherited limitations of first and second sequentially annealed layers, amount to product-by-process limitations. No evidence has been offered showing a capacitor produced according to these limitations is patentably distinct from one which has not been so treated. Accordingly, we find Appellants have not met their burden for showing patentable distinctiveness, *Fitzgerald*, 619 F.2d at 70, and the Examiner's fifth rejection is sustained.

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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